The Role of Personality on Decision Making Under Uncertainty

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A thesis presented to Lakehead University in partial fulfilment of the requirements for the degree of

Master of Arts in Clinical Psychology,

Date: August 25, 2010

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Preface and Acknowledgements

Decision making pervades every aspect of our lives. For over 400 years, academics have attempted to explain the decisions we make. In recent decades psychologists have been exploring patterns in human decision making in an effort to predict how and when people's decisions differ. Perhaps nowhere are these decisions more life-altering that in the realm of medical decision making.

Timely access to appropriate medical care is an important issue, particularly in a publicly funded health care system. For most people requiring the higher level of care available only by admission to the hospital, the Emergency Department physician represents a gate keeper to a limited resource. To others who don't have ready access to a primary care physician, or who require urgent medical attention, the Emergency physician is a safety net. The importance, therefore, of bettering our understanding of how individual and situational factors affect decisions of Emergency physicians is undeniable.

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This Thesis could not have occurred without the contribution of numerous others, to whom I am grateful.

To Rupert Klein, my Primary Supervisor, I would like to express my gratitude for the fastidious guidance over the last two years. You shared (and sometimes helped to reign in) my inquisitiveness and afforded me autonomy to explore new ideas, all the while providing expert feedback to facilitate my academic growth (despite my nearly incorrigible use of run-on sentences!).

I also owe much to Dr. David Mutrie. You've been a mentor and advocate, professionally and personally.

Bruce Weaver, your exceptional technical advice is never taken for granted. I especially thank you for your availability and for continually approaching learning wholeheartedly. Thank you to Dr. Michel Bédard, my 2nd Reader, and Dr. Mary Lou Kelley, my Internal/External Examiner, for setting the bar high. I'm indebted to the faculty and my fellow graduate students in the Psychology Department at Lakehead University for sharing their skills, their ideas, and their encouragement.

Thank you also to the Emergency physicians who participated in this study. Without your continuing personal interest in working with me on this and the projects which led up to it, this research could not have happened. Lisa Begin and Registered Nurses, Susan Bailey and Suezie Koropeski, your contributions are equally valued. Kristi Taylor, you saved my life!

A special thank you goes to Mom and Dad for believing in me through it all and also John and Friday for helping me realize that I might find the answer to "why" all on my own. All my wonderful friends: you've stood by me and teased me when I needed it most, and even convinced me to put down the laptop every once in a necessary while (especially you, Neal and Moira).

Perhaps most of all, Donn: for the late-night patience, brilliantly executed meals, and tireless listening and questioning: You're an inspiration and I love you. Spread your arms and hold your breath. Always trust your cape.

Happy Anniversary John & Patti!

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Abstract

Dispositional characteristics appear to impact peoples' decision making when faced with situations characterised by uncertainty, a characterization of an unknown future outcome, and ambiguity, a characterisation of the present situation where multiple possibilities exist. There is a paucity of decision making research of an applied nature which limits the application of theory to practice. This study investigated the role of dispositional reactions to uncertainty in decision making in an applied medical setting by integrating theory and research findings from traditional economics and emerging cognitive and personality psychology models. We examined the relationship and predictive power of emergency physicians' affective and dispositional reactions to uncertainty and propensity for risk taking in clinical situations when deciding to admit a patient or release them home. Patients who present in the Emergency Department do so with a range of medical complaints, each with a different degree of risk and ambiguity. These properties of the patient/physician encounter were hypothesized to impact individual physicians differently, depending on the physician's trait and state reactions to uncertainty and propensity for risk taking. Specifically, it was hypothesized that Emergency Physicians' admission and discharge decisions and length of time required to arrive at a decision would be impacted by the physician's unique personality features and the degree of ambiguity and risk inherent in the patient's condition. Emergency physicians' dispositional characteristics were not found to play a significant role in the decision to admit patients. Limitations and directions for future research are discussed.

The Role of Personality on Decision Making Under Uncertainty

Introduction

Every person is consistently confronted with making decisions under uncertain (e.g., should I try this experimental new heartburn medication?) and ambiguous (e.g., which brand of painkiller should I purchase?) circumstances. For decades cognitive psychologists have studied how individuals make decisions such as these with the predictable utilization of heuristic biases (Ferreira, Garcia-Marques, Sherman, & Sherman, 2006; Tversky & Kahneman, 1974). Recent research from personality psychology has focused on the individual differences in how comfortable we are in making decisions in these circumstances (Lauriola, Levin, & Hart, 2007) and these may have significant repercussions on our decisions and actions.

One area where personality might have exceptional consequences is in the area of medical decision making where uncertainty and ambiguity are inherent. Specifically in an Emergency Department, where life-altering decisions are regularly made under time pressure and with a heightened degree of ambiguity and risk, physicians are frequently required to make a treatment decision even before collecting all relevant diagnostic information. Should I admit this patient or send them home? The nature of Emergency Medicine precludes most physicians from any means of follow-up or positive feedback on the results of the care they provide. Consequently, without regular feedback emergency physicians are particularly susceptible to maintaining faulty decisional biases. The present study applies theoretical research from cognitive and personality psychology to an applied decision making setting (i.e., Emergency Department medical doctors). The purpose of the following study is to elucidate the role of physicians' personality characteristics when making decisions that involve risk and uncertainty.

Marrying research from the two fields of cognitive and personality psychology and applying it in a medical setting is novel in this area of research. To this author's knowledge no study has looked at the relationship between physicians' personality and actual admission decisions across a spectrum of medical complaints. This forms an important theoretical contribution to the personality psychology literature because the consideration of individual physician and patient factors is a novel approach to delineating under what circumstances, or degree of uncertainty, personality plays a more impactful role in decision making. Additionally, this research has the prospect for applied contributions by potentially improving health care access and resource utilization in a practicable and efficient way.

Literature Review

There is a long history of research on the topic of decision making in the context of uncertainty and risk (Ellsberg, 1961; Kahn & Sarin, 1988). However, the operational definitions of various terms have become amorphous and are at times confused or misrepresented. To disambiguate the terms what follows is an operational defining of the differences between uncertainty, ambiguity, and risk.

Uncertainty, ambiguity and risk

Uncertainty is a characterization of a future event with an unknowable outcome. For example, in the opening line of this thesis the example of trying an experimental medication results in a feeling of uncertainty since the outcome is unknowable. This concept is distinct from the related notions of ambiguity and risk.

The term "ambiguity" is often used synonymously or interchangeably with uncertainty in circular dictionary definitions and more troublingly, in academic and research literature (Grenier,

Barrette, & Ladouceur, 2005). The confusion stems in part from their shared features; both concepts involve the interpretation of unknown properties in the environment and both have been measured as a personality trait in terms of one's cognitive, emotional, and behavioural reactions to the unknown (Grenier, et al, 2005; Oshio, 2009). Personality psychology researchers espouse a distinction between the individual characteristics of intolerance of ambiguity and intolerance of uncertainty. Krohne argued that ambiguity refers to a stimulus or situation's inherent properties, such as being unpredictable or complex, and uncertainty is an emotion experienced as a reaction to the ambiguousness of a situation. The distinction made by Krohne is reflected in subsequent research. A review of the literature by Grenier and colleagues (2005) found a time-oriented distinction where the characteristic of intolerance of ambiguity is a reaction to elements of the present situation whereas intolerance of uncertainty is a future-oriented emotion state. When measuring an individual's uncertainty and reactions to ambiguity Butler and Mathews (1987) found that intolerance of uncertainty is a more global dispositional trait. A person's reaction to the ambiguity of the present situation is better defined as a state-specific characteristic.

For the purpose of the present study, uncertainty is defined as a characterization of an unknown future outcome and ambiguity is defined as characteristics of the present situation where multiple possibilities exist. In simpler terms, uncertainty is conceived as *ignorance* about possible outcomes, while ambiguity is better represented by *confusion* about existing possibilities (Weick, 1995 in Saint-Charles & Mongeau, 2009). Misunderstandings over the definition of ambiguity and uncertainty obfuscate any discussion of the decision-making literature. In the interest of promoting continuity and clarity subsequent mention of uncertainty and ambiguity will adhere to the definitions outlined above, and not necessarily the terminology of the original researcher(s).

The distinction between decisions involving uncertainty and those involving risk was classically made by Ellsberg (1961) and rests on whether some probability of an outcome is known to the decision-maker. Ellsberg's definition made no distinction between what is knowable and what is known. In uncertain decision-making the decision maker is faced with at least one option characterized by "uncertainty about uncertainty" (Kahn & Sarin, 1988, p.265); that is, where the distribution of outcome probabilities is unknown. In decisions involving risk the probabilities are known, but the specific outcome is not. Risk, therefore, is defined as an event where possible outcomes and their given probabilities are fully known, whereas an uncertain event is one where possible outcomes are known but their probabilities are not. Ambiguity, risk, and uncertainty are commonly encountered in medical decision making, as can be seen in the following scenario.

When a 75 year old gentleman arrives in the Emergency Department complaining of chest pain the situation is highly ambiguous. Is he experiencing a heart attack or the effects of an untreated ulcer or something else? Following a thorough history-taking and diagnostic testing, the physician determines that the patient suffers from unstable angina, a blocked coronary artery, thus resolving the ambiguity. Treating him with medications reduces the immediate, known, high risk of a heart attack, but the physician must still decide whether to send the patient home until consultation with a cardiologist can be arranged or admit him for inpatient monitoring. Diagnostic tests will inform the physician's decisions with regard to known risk factors, while other factors will add to uncertainty regarding the patient's prognosis. Will this patient adhere to the physician's treatment plan and will his family be available to support him adequately at home? How susceptible is this elderly patient to infection or the negative effects of immobility associated with inpatient care? Furthermore, there is inherent uncertainty, or unknown

probabilities, of the condition worsening or becoming aggravated, which could result in a heart attack. All these factors impact the physician's degree of uncertainty when deciding whether to admit a patient, and must be balanced within the constraints of a health care system with a limited number of available inpatient beds.

Expected Utility Theory

Expected Utility Theory offered a formalized model of decision making under uncertainty but could not adequately explain peoples' simultaneous preferences for safety and risk. Economic theorists speculated that logic-based decision-making is universal, paving the way for cognitive and personality psychologists to further refine and investigate the underlying mechanisms that contribute to decision-making under risk and uncertainty.

Since the 17th century, theories have been put forward to explain and predict patterns of decision-making in uncertain situations. The St. Petersburg Paradox was posed in 1713 by Nicholas Bernoulli, and described a situation where a fair coin would be tossed until a head appears. If the first head appears on the nth toss, then the payoff is 2n ducats (gold coins). Bernoulli asks the question: How much should one pay to enter the game? The paradox is in the infinite expected winnings, but that people would be unwilling to pay an infinite amount to be able to play the game. The notion of expected utility originated from Daniel Bernoulli, cousin to the former Bernoulli, in 1738. Bernoulli's solution to the St. Petersburg Paradox was twofold. Firstly, he conceived the idea that people's utility from wealth is logarithmically (rather than linearly) related to wealth. Put another way, the concept of *diminishing marginal utility* contends that the value of something increases more and more slowly as the quantity consumed also increases. Secondly, Bernoulli tendered the idea that the value a person places on a risky choice

is not based on the expected return, but rather a subjective valuation of how useful that return will be to the player, or what Bernoulli dubbed its *expected utility*. Using the gold coin example, diminishing marginal utility stipulates that a person who already possesses two gold coins will value winning a single, third gold coin more than a person who has one hundred gold coins will value winning the single additional coin. Bernoulli's expected utility further suggests that the person with two gold coins will only accept the risk involved in winning a third gold coin if three gold coins is useful, that is if it's enough to purchase something that he wants.

Economists and mathematicians were prolific in their explorations of diminishing marginal utility (see Van Daal (1996) for a discussion of Gossen (1854); Jevons, 1871; Menger, 1871/2007 for examples) but, with very few exceptions, expected utility was ignored. Over 200 years later the time for expected utility came when Expected Utility Theory (EUT) was popularized by von Neumann and Morgenstern (1944). EUT is formulaically similar to Bernoulli's theory but differs in how people determine an outcome. Bernoulli states that outcomes are inherently obvious and can objectively be interpreted by the individual. For Bernoulli, the utility of an outcome defines an individual's preference for that option. In contrast, EUT states that an individual's preferences describe the utility of the option, therefore allowing for an individualized expression of utility. Von Neumann and Morgenstern suggest that when individuals are faced with random prospects that they try to find the best choice. A person's preferences are explained in terms of the weighted probability of an outcome and its implied utility for the individual. By explicitly defining individual preferences for certain outcomes in terms of axioms, or principles, von Neumann and Morgenstern were the first to propose the *how* of thinking to decision-making. For example, the *transitivity* axiom states that if a pill is preferred over an exercise regime and the exercise is preferred over surgery, a pill will

also be preferred over surgery. The *dominance* axiom holds that if multiple medication brands are equal in all aspects, but one comes in a preferred flavour (that is, one option is better on at least one aspect), it will be selected based on that one benefit. A third axiom is that of *invariance* which states that preference should remain unchanged regardless of order of presentation. When a decision maker is indifferent about multiple outcomes they will be equally indifferent about multiple options with an equal likelihood of different outcomes, this is known as the *substitution* axiom as one option could acceptably be substituted for another. Not every individual will come to the same decision when following the same axioms, though each will strive to maximize his/her personal subjective expected utility. The EUT approach is far more inclusive than Bernoulli's interpretation, as he defined preferences by the utility of an outcome only and ignored how individual perceptions alter how the value of an outcome is subjectively measured.

The von-Neumann-Morgenstern expected utility axioms formalized the model of rational behaviour in the face of uncertainty. However, systematic violations of the axioms have since been shown. The Allais Paradox (Allais, 1953) showed that, when faced with a set of 2 dichotomous gambles where one must first choose between Situations A and B,

Situation A:

- certainty of receiving 100 million dollars

Situation B:

- a 10 per cent chance of winning 500 million dollars,
- an 89 per cent chance of winning 100 million dollars,

- a 1 per cent chance of winning nothing

And subsequently, between Situations C and D:

Situation C:

- an 11 per cent chance of winning 100 million dollars,
- an 89 per cent chance of winning nothing.

Situation D:

- a 10 per cent chance of winning 500 million,
- a 90 per cent chance of winning nothing (Allais, 1953/1990, p.5),

subjects' choices demonstrate a maximization of expected utility in the first case only. Selecting A over B maximizes utility and not value because Situation B has a higher value than A. Following the same logic, in the second set of options subjects should have chosen Situation C over D. However, subjects overwhelmingly chose Situation D over Situation C, thus violating the substitution axiom postulated in EUT by selecting on the basis of maximizing expected value, rather than utility. The paradox lies in the inconsistency of choice across the two gambles.

Daniel Ellsberg's thought experiment presents subjects with two urns. Urn 1 contains 100 red and black balls but the ratio is "entirely unknown to you" (Ellsberg, 1961, p.650). Urn 2 has 50 red balls and 50 black balls, the ratio is known. The task is to choose an urn from which to draw a ball, and bet on which colour ball will result. There is a hypothetical prize of $100 for drawing correctly, and $0 for an incorrect draw. Overwhelmingly, subjects in Ellsberg's subject pool admittedly "under absolutely nonexperimental conditions" (p.651), preferred to select a ball

from the second urn, that with known probabilities, over the unknown first. In violation of EUT, the Ellsberg paradox demonstrated that events with known probabilities are preferred to the unknown, even when the known choice does not maximize the potential benefit, or expected utility, for the individual (Ellsberg, 1961). EUT assumed a rational approach to decision making when faced with uncertainty therefore subjects should have taken a rational approach and selected both urns equally. Ellsberg's now-famous experiment continues to be replicated and receive attention in the academic literature (Cherry & Shogren, 2007; Curley, Yates, & Abrams, 1986).

Cognitive psychology

The decision-making literatures on ambiguity and risk-taking are generally the domain of two separate branches within psychology: cognitive psychology and more recently personality psychology. The ample experimental research on risky decision-making generally involves highly controlled and contrived choice dilemmas or gambling tasks. Critics have contended that inferences made from the tradition of artificial experimentation lack external validity or practical applicability to real life decision-making (Loewenstein, 1999; Schram, 2005). In general, they argue, real probabilities are rarely if ever known and the subjective manner in which they are inferred varies from individual to individual, making it impossible to measure reliably. Regardless of whether the findings of pure research psychology are applicable in applied decision-making settings, key studies merit mention here as both contributors to and the impetus behind personality psychology's foray into the empirical study of decision making.

Prospect Theory and Cumulative Prospect Theory.

From the cognitive psychology literature Daniel Kahneman and Amos Tversky proposed Prospect Theory (PT, 1979), their own critique of EUT. Where EUT was prescriptive, showing how people ought to behave in the face of uncertainty, PT is descriptive and concerns itself with how decisions are actually made (Montier, 2002, p.20). PT sought to explain contradictions and asymmetry in human behaviour, which runs counter to what would be expected under EUT. When managing risk and uncertainty people have a tendency to underweight probability (uncertain) outcomes compared to known certainties, a phenomenon known as *certainty effect*. For example, if Treatment A leads to a 20% chance of death and an 80% chance of a normal life for 30 years and Treatment B leads to a 100% chance of a normal life for only 18 years, decision makers will select the second treatment even though EUT would predict the opposite, "decision makers, be they physicians or patients, have a high preference for certain outcomes, regardless of the comparative utilities associated with them" (Kattan, 2009, p.122). Kahneman and Tversky also showed that people are susceptible to *isolation effects* in which decisions are affected by how information is presented or framed. Treatments described to physicians in terms of survival rates are selected over treatments described using probability of dying (Kattan, 2009). Given the option of a certain gain subjects displayed risk-averse decision-making, but the opposite style of decision-making, risk-loving, was evident when decisions involved losses. Kahnemann and Tversky labelled this phenomenon the *reflection effect*. For example, subjects will choose a guaranteed week-long European vacation (certain gain with no risk) over a 50% chance of receiving a three week long European vacation (risky option, possibility of no gain). However, when the choice involved a loss, subjects displayed risk-seeking behaviour by overwhelmingly selecting the option of an 80% chance of losing $4000 (risky option, possibility of greater loss)

over a certain loss of only $3000 dollars. PT posits a two-stage model of decision making under uncertainty. In the first stage the actor first performs a preliminary analysis of the options, essentially editing the available prospects into simple representations. During the second stage the decision maker evaluates the simpler options and chooses the one with the highest value. During the editing phase, the decision-maker codes potential outcomes as gains or losses as compared to some reference point, generally one's current state. Changes in reference point "alters the preference order for prospects" (p.286). By elucidating the tendency to overweigh small probabilities, be they positive or negative, PT addresses the predisposition of decision-makers to favour both safety and risk, something EUT could not accomplish. For alternate critical perspectives, (see Nwogugu, 2005[1] and Kahneman & Tversky, 1992; Fennema & Walker, 1997[2]).

Porcelli and Delgado (2009) hypothesized that PT's reflection effect (the tendency for one to prefer a risky option over a sure thing when decisions involve losses and a sure thing over a risky one when the risk involves gains) might be exacerbated in situations involving acute stress. Using the cold-pressor[3] task as a means of inducing stress and measuring risk-taking by means of a gambling task, the researchers proposed that under stressful conditions an

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[1] There have been mounting criticisms of PT on the basis of its rigid, abstract quantitative model probing its applicability with non-monetary outcomes and Kahneman and Tversky's use of "questionable" research methods (Nwogugu, 2005, p.151).

[22] In 1992, Kahneman and Tversky updated PT to incorporate rank-dependent aspects of decisional structure. Under the new model, ranked probabilities are weighed cumulatively, rather than individually. They labelled their new theory Cumulative Prospect Theory (CPT, Kahneman & Tversky, 1992). The basic notion of CPT is that ranking takes place separately for probabilities associated with gains and for probabilities associated with loses, which are then combined to arrive at a decision. CPT however, has suffered many of the same criticisms as its predecessor, "CPT is indeed a generalization of expected utility" (Fennema & Wakker, 1997, p.56).

[3] The cold pressor task is a method of pain induction used in experimental research. The task involves submerging one's hand or limb in temperature-controlled cold water to induce mild to moderate intensity pain which can be terminated by voluntarily withdrawing the hand.

individual's ability to make decisions can become impaired. Results were interpreted to mean that more risk-taking resulted from a reliance on lower-level, automatic cognitive functions. This is in line with Easterbrook's Cue Utilization Hypothesis, proposing that "emotional arousal acts consistently to reduce the range of cues that an organism uses, and that reduction in range of cue utilization influences action," (Easterbrook, 1959, p.183). Complex tasks such as medical decision-making often involve consideration of many cues. In a heightened stress situation such as an emergency department, a physician may only perceive a limited number of cues and make a riskier decision such as sending a patient home rather than admitting them (a conservative non-risky decision). Under a state of higher than normal arousal people show inflexible perseverance in the use of previously successful strategies (Carr & Steele, 2009) suggesting that they have difficulty abandoning old strategies in favour of newer, more efficient ones. For the emergency physician who has typically admitted most patients with chest pain, they may be more resistant to utilizing a new outpatient Cardiology service meant to decrease unnecessary hospital admissions.

The aforementioned research on decision making has been recently validated with neuroimaging. Using fMRI, differing neural mechanisms were shown to be in use during the two types of decision-making. Subjects made decisions between pairs of monetary gambles from any of three conditions; a certain outcome, an outcome with known probabilities (risk condition), or an outcome with unknown probabilities (ambiguity condition), which varied across trials. Brain activation was significantly greater in decisions involving ambiguity compared to decisions involving risk, suggesting that decision making under ambiguity is more than a specialized form of risk or particular form of decision making under risk conditions (Huettel, Stowe, Gordon, Warner, & Platt, 2006). Weller, Levin, Shiv, and Bechara (2007)

demonstrated an inequality in the effect of brain damage on decisions involving loss and those involving gain, depending on the area of the lesion. When making risky decisions, decision making was more easily disrupted when decisions involved potential gains than when decisions involved potential losses. Individuals with damage to the amygdala, an area associated with emotional responding, showed impairment in decision making only when considering gains. Individuals who had suffered damage to the ventromedial prefrontal cortex, an area where cognitive and emotional information becomes integrated, were deficient in decision making involving both gains and losses. These patients persisted in taking unnecessary risk regardless of the likelihood of success. Further, these results support the notion that decision making in the face of uncertainty involves an affective component and is not a solely cognitive process.

Personality psychology

The differentiation of known and unknown probabilities is significant for both the experimental and personality psychology literatures, as is the distinction between decision-making to achieve a gain and decision-making to avoid a loss. Borrowing the traditional static, lab-based decision-making tasks of their cognitively-oriented colleagues, personality researchers linked a preference for known versus unknown probabilities to measures of suspiciousness and harm avoidance (Johnson, Rustichini, & MacDonald, 2009), and lower levels of sensation-seeking (Zuckerman & Kuhlman, 1978; Wong & Carducci, 1991). More risky decision-making has been similarly linked to dimensions of impulsivity (Dahlback, 1990a), narcissism (Lakey, Rose, Campbell, & Goodie, 2008), self-reported criminality (Dahlback, 1990b), depressive symptoms (Smoski, et al., 2007), and having a Type A versus Type B personality (Wong & Carducci, 1998).

Laurioloa and Levin (2001a) conducted an exploratory investigation into the relationships among the Big-Five personality factors (openness-to-experience, conscientiousness, extraversion, agreeableness, and neuroticism), demographic variables, and risk-taking. Participants were asked to choose between pairs of equivalent contracts of certain and potential gains or losses with varying probabilities. Results showed a higher propensity for risk-taking to achieve gains in subjects who scored low on Neuroticism and high on Openness to Experience. There were no significant effects when the goal was to avoid a loss, except in the case of Neuroticism. After controlling for gender and age, individuals scoring high on Neuroticism were more likely to take risks to avoid a loss[4]. The authors proposed the differential effect of sadness and anxiety, both features in the construct of Neuroticism, as a possible explanation for the "two-fold role" (p.224). Raghunathan and Pham (1999) showed that low-risk options are more attractive to anxious individuals and high-risk options are favoured by sad individuals. In the study of decision-making under uncertainty and risk, therefore, narrower personality measures like *reactions to uncertainty* may provide researchers with more informative results than broader measures such as the Big-Five.

Personality researchers have assessed the role of certain dispositional tendencies (e.g., power motivation and optimism) on decision making in various applied settings (e.g. business and patients' treatment decisions) that involve uncertainty. However relatively few applied studies have been conducted which explicitly attempt to take into account the uncertainty of the situation or the decision maker. Farah, Yechiam, Bekhor, Toledo, and Polus (2008) explored the

[4] These results were not replicated in a subsequent study by Brand and Altstotter-Gleich (2008) which aimed to assess the relationship of personality to decisions under uncertainty and risk-taking. Only the dimension "concern over mistakes," an aspect of Perfectionism, was significantly correlated with selecting low-risk options. Inconsistencies may stem in part from the small sample sizes (fewer than 100 subjects) in both studies and underscores the need for replication.

construct of cognitive impulsivity in the applied setting of driving. Participants found to be consistently faulty in their decision making on the Iowa Gambling Task (IGT) by persistently selecting from card decks that resulted in greater losses made more overtaking manoeuvres and were less likely to abort when faced with potential threat, drove faster, and accelerated faster in a driving simulation task. For this group of participants, weighing gains more than losses was significantly correlated to more overtaking manoeuvres, independent of gender and age. Citing previous research which established a connection between overtaking manoeuvres and the risk of a crash, and the latter with greater driving speed, the authors proposed that drivers who show more impulsivity by weighing gains over losses are more risk prone than drivers who do not (Farah et al., 2008). A similar study by Lev, Hershkovits, and Yechiam (2008) found similar results in a sample of traffic offenders. Traffic offenders repeatedly weighed gains over losses and made fewer advantageous choices on the IGT. Orom and colleagues (2009) are among the few researchers to explore the role of disposition in an applied health care setting. Men with prostate cancer who scored low on dispositional optimism experienced more difficulty making decisions about their treatment (Orom, Penner, West, Downs, Rayford, & Underwood, 2009). Clearly then, the impact of dispositional traits on decision making vary by situation, such as when there is uncertainty or risk. Physicians' discrete personality differences, such as intolerance of uncertainty, reactions to uncertainty, and propensity for risk-taking, will have the potential to influence medical decisions, directly effecting the course of patient care.

Affective reactions to uncertainty as a dispositional trait.

In a series of experiments, Lauriola, Levin, and Hart (2007) built on the findings and methods of Ellsberg (1961), Kahn and Sarin (1988), and others to show that reactions to ambiguity and risk met the defining features of a dispositional trait to reduce uncertainty in

decision making: stability over time and consistency across situations/tasks. The *Ambiguity-Probability Tradeoff Task* (Lauriola & Levin, 2001b) is a forced choice task between ambiguous urns containing an unknown proportion of balls in two colours and unambiguous urns with known proportions of balls of the same two colours (modelled after Ellsberg's "two colour problem"). The proportions, colour-pairings, and positions of urns are then randomized over 27 trials. The task is thought to measure "one's intrinsic attitude toward ambiguity based on a set of observable preferences" (Lauriola et al., 2007, p.132). Unreliable responses and "careless" responses were removed from analyses. While most of the 1087 eligible respondents were neutral (within one standard deviation above or below the mean) in regards to their attitude toward ambiguity, a small group of subjects showed a statistically significant preference for either ambiguity-seeking or ambiguity-avoiding responses. Using the extreme groups design, the researchers were then able to predict subjects' risk preference on a gambling task with variability in the presence of a gain or loss, finding that risky choices were significantly more likely for extreme ambiguity-seekers than extreme ambiguity-avoiders, and that risk-taking was more likely when the risk involved a potential loss. Using a combination of repeated measure analysis of marginal effects and a multilevel item response model, the researchers controlled for intra-individual differences to further define a "core factor" between attitudes toward risk and ambiguity. In a second study a 14-item Ambiguity-Probability Tradeoff Task (number of items was reduced to prevent the high level of careless responding seen in Study 1) was administered to identify extreme groups, who were contacted two to four weeks later to participate in an ambiguity task with "real life" scenarios. Scenarios included decisions about items such as health, emergency preparedness, environmental stewardship, investing, and fresco painting restoration. Participants were required to choose between well-established treatment or program

and one that was newly established and untested. In these real-life scenarios, domain-specific differences were evident across the groups, showing that reactions to ambiguity are flexible when there is information available on which to evaluate the scenario (unlike the urn tasks). However, responses on the urn task were still predictive of responses on the real-life scenario task, cross-validating the authors' conclusion that there is stability over time and domain in a decision-makers' reactions to decisions under uncertainty. Ambiguity-avoiding was consistently associated with risk-aversion. A third study was performed using the Ambiguity-Probability Tradeoff Task, various measures of risk-taking and personality, and hypothetical "real life" scenarios. Participants were asked to select from two options; one option was described as well-established and had known probability levels while the other hypothetical option (the ambiguous option) was described as "new" and of unknown probability for success. Scenarios covered decisions about medical treatment and business/investment. Results showed a significant positive correlation between ambiguity-avoiding and having a regret-based decision style (r = .22, p<.01), and a negative correlation with Optimism (r = -.25, p<.01) and *Tolerance for Ambiguity* (r = -.015, p<.05). In addition, hypothetical patients who selected the less ambiguous treatments did so consistently, suggesting the stability of the trait to reduce uncertainty in decision making across settings. Physicians who tend to admit ambiguous patients more often, then, may do so in an attempt to avoid later feelings of regret, because they feel less optimistic about possible patient outcomes, or to reduce their discomfort in the face of ambiguity.

Intolerence of uncertainty.

Uncertainty is defined as a characterization of an unknown future outcome. Intolerance of uncertainty was defined by Dugas, Hedayati, Karavidas, Buhr, Francis, and Phillips (2005) as "a cognitive bias that affects how a person perceives, interprets, and responds to uncertain

situations on a cognitive, emotional, and behavioural level" and is manifested in "an excessive tendency to find uncertain situations stressful" and the belief that unexpected events are unfair and should be avoided (p.58). Individuals high in the personality trait of intolerance of uncertainty will find it unacceptable that a negative even may occur, even when the probability of its occurrence is very small (Dugas, Gosselin, & Ladouceur, 2001, in Buhr & Dugas, 2002), are more likely to recall uncertain information, and more likely to interpret ambiguous information as threatening (Dugas, et al., 2005). Furthermore, these individuals overestimate the probability of an unlikely event occurring (Dugas, Freeston, & Ladouceur, 1997). When making treatment decisions in the Emergency Department, physicians high in intolerance of uncertainty may find cues to a negative outcome more salient and misjudge the likelihood of a poor outcome for the patient. These individuals, compared to those with less intolerance of uncertainty, have a higher need to resolve anxiety resulting from ambiguity and uncertainty in their environment, and they may do so by admitting a patient with ambiguous symptoms or an uncertain course, rather than discharging them.

The role of worry.

Worry is defined as the concern about future events which involve uncertainty about the outcome (MacLeod, Williams, & Bekerian, 1991). Worry, as it is closely related to anxiety, likely plays an important role in decision-making where there is uncertainty about outcomes. Individuals high in intolerance of uncertainty may be at risk for developing excessive worry because of their tendency to selectively attend to and recall threatening information and interpret ambiguous information as threatening (Dugas *et al*., 2005). Indeed, specifically targeting intolerance of uncertainty with cognitive-behaviour therapy techniques leads to changes in level of worry (Dugas & Ladouceur, 2000).

Worriers have been shown to have increased evidence requirements, they need more information, before making a decision (Tallis, Eysenck, & Mathews, 1991). In contrast, individuals high in trait anxiety have been found to have an implicit goal of uncertainty reduction and a tendancy to gather *less* evidence before making a decision (Bensi & Giusberti, 2007). In the context of medical decision making, these findings are not as mutually exclusive as they appear. Faced with a patient with an uncertain prognosis, the physician's decision to admit, rather than discharge, a patient may be a reaction to what the physician interprets as a lack of adequate information. In essence, the decision to admit the patient is a decision not to make a decision, which reduces the physician's uncertainty.

Variability in Physician Decision Making

The literature pertaining specifically to physician's medical decision making is plagued by many of the same external validity and generalizability problems that face research in the cognitive and personality areas of psychology because of their reliance on simulated cases or highly specific clinical scenarios.

In his quintessential studies showing variability in physician decision making, Nightingale (1987a, 1987b, 1988) asked physicians to select from hypothetical treatment options with a certain loss of years of life expectancy and a 50/50 gamble of losing either five or ten years or no years of life expectancy. Risk taking in the face of a certain loss was significantly correlated with increased test ordering ($p<.01$), whereas risk preference in the face of gain was unrelated to physicians' test ordering for hypothetical cancer patients (Nightingale, 1987b). Physicians who chose a certain loss of years of life (risk-avoiding) over a gamble of 10 years lost or no years lost (risk-preferring) ordered 23% fewer laboratory tests over an eight week period

than less risk-averse physicians. The finding was robust even when the years of life lost in the certain loss condition was stratified as one, two, three, four, or five years lost. Individual emergency physicians' preference for risk was related to a higher admission rates ($t = 3.49$, $p < .001$) in (presumably more ambiguous) general medical patients but not Intensive Care or Intermediate Care patients (1988). The distinction between test ordering and admission decisions among risk-preferring and risk-avoiding physicians suggests a significant influence of physician disposition on clinical decision making in an applied setting, with a significant impact for health resource utilization. In contrast, Pearson, Goldman, Orav, Guadagnoli, Garcia, Johnson, et al. (1995) modified the risk-taking scale of the Jackson Personality Inventory (MJPI-R) for use as a measure of risk seeking in emergency physicians to study triage decisions in patients with chest pain. Results showed that risk-seeking physicians were only half as likely to admit a patient as those with moderate risk scores, while the risk-averse physicians were twice as likely as moderate-scoring physicians to admit a patient with chest pain. Primary-care internists showed a similar relationship between risk-taking propensity, measured by MJPI-R, and resource use. Internists with a higher risk-taking propensity had decreased total resource use (-8% per SD, $p = .02$; assessed by monetary cost) (Allison, Kiefe, Cook, Gerrity, Orav, & Centor, 1998). Combined, these findings illustrate the importance of distinguishing among patient and physician characteristics in the study of risk-taking.

Physicians overestimated chest pain patients' risk of complications and seem to admit these patients more often. Researchers asked 147 physicians (emergency physicians, internists, and cardiologists) to estimate the risk of complication in simulated cases of patients presenting to the Emergency Department. Analyses showed that physicians overestimated patients' risk of complications and admitted more patients than would have been decided using a medical

decision making rule. Across specialties, level of training, and years of clinical experience, estimates of major complications, diagnoses, and decisions varied widely (Reilly, Evans, Schaider, & Wang, 2002). Mutrie, Bailey, and Malik (2009) validated this earlier study using actual rather than hypothetical physician decisions in an Emergency Department setting. These researchers showed that emergency physicians' actual admission decisions over a 12 month period varied significantly and were not explained by specialization, years of experience, or various patient and health system variables such as patient age, gender, physician's knowledge of family or patient preference, general or specific recall of a similar case, considering the opinions of peers or hospital administrators, and other factors. Comparing referral decisions by generalists and specialists, generalists were influenced by non-medical reasons in 76% of cases, and by solely medical reasons in 20% of cases. Generalists and specialists failed to agree in 34% of referrals (Donohow, Kravits, Wheeler, Chandra, Chen, & Humphries, 1999), giving emphasis to the differences in medical decision making between specializations mentioned in the preceding paragraph. Whether differences in physicians' clinical decisions between specialties are explained by temperamental differences that attract a physician to one specialty or another, or type of training, or a combination of these and other factor remains to be seen. Distinguishing among areas of medical specialisation is therefore a valuable approach in clinical decision making research.

Preliminary Study

A preliminary study was conducted to test the relationship between physician admission patterns and dispositional characteristics related to uncertainty and risk. Emergency physicians' decisions to admit certain patients, rather than discharge them, may be an attempt to reduce psychological discomfort resulting from their individual reactions to the ambiguity or uncertainty

inherent in a clinical situation. The relationship between dispositional factors such as intolerance of and reactions to uncertainty and admitting may be influenced by diagnostic ambiguity or illness severity. This relationship had not previously been investigated. The purpose of this preliminary study was to investigate the relationships between personality factors and critical decision making during clinical encounters with differing levels of uncertainty. All physicians employed in a regional, high volume Canadian Emergency Department were asked to complete a questionnaire including the two subscales from the Revised Physicians' Reactions to Uncertainty Scale (PRU-R, Gerrity et al, 1995; Anxiety due to Uncertainty and Concern About Bad Outcomes), and the Intolerance of Uncertainty Scale (IUS, Buhr & Dugas, 2001). Diagnostic uncertainty was objectively defined using the Canadian Triage and Acuity Scale (CTAS) scores which range from 1 (most severe, highest acuity) to 5 (least severe, lowest acuity). Uncertainty is considered to be any diagnostic decision with a score of two (*emergent*) or three (*urgent*) on the CTAS.

Physician admitting practices were assessed over a six months period. All clinical encounters in the Emergency Department (33,230 patient visits) were included in the analyses. A regression analysis with IUS and as predictors and CTAS-specific admission rate as the criterion was conducted. When a patients' illness was ambiguous (i.e., CTAS scores of 3), the PRU-R subscales "Anxiety due to Uncertainty" (ß=-.86, $p<.05$) and "Concern About Bad Outcomes" (ß=.83, $p<.05$) were significant predictors of admitting behaviour ($R^2=.31$). When illness was only moderately severe (CTAS 2), only Anxiety due to Uncertainty made a significant contribution, although the model was not significant.

When illness is urgent (CTAS 2) or emergent (CTAS 3), rather than mild (CTAS 4) or severe (CTAS 1), potential outcomes are thought to be more ambiguous. Under these

circumstances, the inherent uncertainty of the situation appears to activate anxiety in some physicians subsequently altering their decision making (i.e. admission rate). The decision to admit these moderately ill patients may at times be an attempt to reduce anxiety caused by uncertainty about clinical outcomes. The authors concluded that tolerance of and reactions to uncertainty plays a larger role in decision making for moderately ill than severely or mildly ill patients. However, further refinement of the model is required. To better understand the role of physician disposition in medical decision making this thesis will differentiate patients according to degree of ambiguity and risk at the time of their entrance to the Emergency Department and include a low ambiguity, low risk control group. The addition of analyses which include patient's length of stay in the Emergency Department before a physician's disposition decision (admit or discharge) are expected to further elucidate the effect of physicians' individual dispositional differences for health care delivery.

Rationale for the Present Study

Emergency Department overcrowding occurs when there are fewer treatment beds than patients, resulting in wait times which exceed an acceptable standard of care and patients being monitored, sometimes to their detriment, in nontreatment areas such as hallways (Asplin, Magid, Rhodes, Solberg, Lurie, & Camargo, 2003). The most frequently cited reason for Emergency Department overcrowding is an overabundance of admitted patients in the Emergency Department awaiting an inpatient bed (Asplin et al., 2003; Fields, 2003). It was estimated that between 30 and 40 per cent of patients did not receive medical treatment according to the available evidence (Grol & Grimshaw, 2003). In addition to the health outcome concerns for patients stemming from inconsistent treatment and care, suboptimal clinical decisions result in unnecessary admissions to inpatient beds (Mutrie, 1999) that increase the burden to a system

already at capacity (Drummond, 2001). Additionally patients requiring an alternate level of care (non-acute) account for 10 to 25 per cent of inpatients in Ontario acute care hospitals (Drummond, 2001). It is possible that the dispositional characteristics of some physicians compromise their clinical decision making resulting in unnecessary admitting, and therefore contributing to the Emergency Department overcrowding problem.

Variability in physician decision making may be indicative of suboptimal clinical decisions (Mutrie, et al., 2009; Tamayo-Sarver, Dawson, Cydulka, Wigton, & Baker, 2004) Various attempts have been made to improve patient care and decrease health care costs in hospital Emergency Departments through attempts to decrease variability in medical decision making (Gantt, 2004; Hassan, 2003; Katz, Aufderheide, Bogner, Rahko, Brown, & Brown, 2006; Proudlove, Gordon, Boaden , 2003;). Adherence to decision rules and practice guidelines by physicians is generally low (Katz et al., 2006; Lang, Wyer, Haynes, 2007). In an applied study of physicians' decisions regarding patients with low-risk chest pain, those kept for observation had similar outcomes to those sent home at four weeks and six months (Koukkunen, Pyorala, & Halinen, 2004). This suggests that taking longer to come to a clinical decision does not affect the quality of the decision. Moreover, when Emergency Departments have implemented special observation wards for more ambiguous patients an increase in inappropriate care and decrease in physician's decision making resulted. Physicians often held patients longer and had a tendency to admit patients for observation whom they would previously have sent home thereby avoiding difficult clinical decisions (Cooke, Higgins, & Kidd, 2003). Interventions which target the specific needs of decision makers may be more appropriate than the generalized approach to improving clinical decision making utilized thus far. The implementation of observation wards and Clinical Decision Units have been ineffective for improving efficiency and medical decision

making with many patient populations (Bond & Wiegand, 1997; Brillman & Tandberg, 1994; Sinclair & Green, 1998), possibly because they result in prolonging anxiety in the face of clinical ambiguity rather than specifically addressing the decision-making needs of the physician. The development of more effective interventions to improve medical decision making requires thorough, theoretically driven investigations to determine what types of interventions are needed and predict under which circumstances they are likely to be impactful.

Hypotheses

Hypothesis 1

Based upon Ellsberg's studies, which showed that all individuals prefer known probabilities to unknown probabilities, emergency physicians are expected to have a higher admission rate for the High Ambiguity categories than the Low Ambiguity categories, regardless of the level of risk. For example, based on previous research (Bailey et al., 2009) it is expected that all physicians will admit more patients with the highly ambiguous and high risk complaint of chest pain and admit fewer patients who present with equally high risk, but unambiguous stroke.

Hypothesis 2

Emergency physicians are expected to be most anxious when forced to make a decision when there is more uncertainty about the outcome. Feelings of anxiety lead to longer periods of indecision for some individuals (MacLeod & Donnellan, 1993; Laguna & Babcock, 1997). When given the opportunity to delay clinical decisions by holding patients in observation wards Emergency physicians routinely overuse the wards, presumably to avoid decision making when they are uncertain about clinical outcomes (Crenshaw, Lindsell, Storrow, & Lyons, 2006). The variability amongst physicians in the time spent holding patients in the Emergency Department

may be explained by a physician's tolerance for uncertainty. Physicians with more trait intolerance of uncertainty, as assessed by the Intolerance of Uncertainty Scale (IUS), will take longer to arrive at a decision to admit or discharge the patient.

Hypothesis 3

Some physicians may have a higher degree of anxiety when uncertain about their decision to admit a patient. This relationship between the degree of physician anxiety and admission practices is expected to be moderated by the level of ambiguity in the patients' presenting complaint and the level of risk in making a suboptimal decision. Specifically, the relationship between physician admission rates and physicians' individual reactions to uncertainty, as assessed by the Revised Physicians Reaction to Uncertainty Scale (PRU-R) is expected to be moderated by the level of ambiguity and risk in patients' presenting complaint. To the researcher's knowledge this will be the first analysis of its type to use multiple levels of ambiguity and risk in the criterion variable.

Hypothesis 4

Physicians' risk preference may be negatively correlated with resource utilization and admitting behaviour. Allison and colleagues (1998) and Pearson et al. (1995) assessed physicians' propensity for risk taking with the modified Jackson Personality Index Risk taking scale (MJPI-R) but failed to control for features of the patients' illness which may have a significant role in the strength and direction of relationship. In contrast, Nightingale (1988) showed a positive relationship between risk-seeking and physician's admitting behaviour. This refined analysis distinguishes degree of patient risk and illness ambiguity to clarify the role of physician risk-taking propensity in hospital admission decisions. Dispositional risk preference

will be measured using the MJPI-R. Higher scores (risk-avoiding) are expected to more strongly and positively correlate with a physician's admission rate in higher risk than lower risk patients. To the author's knowledge no previous research has investigated the role of emergency physicians' propensity for risk taking in an applied hospital setting with patients stratified by level of associated clinical risk. Confirmation will be in contrast to the findings of Nightingale and highlight the importance of distinguishing degree of patient risk and clinical specialization in medical decision making research.

Hypothesis 5

Based upon the prior hypotheses, the dispositional characteristics of emergency room physicians are expected to have an effect on admission decision making during ambiguous situations. It is unclear whether state or trait reactions to uncertainty, assessed by the PRU-R and IUS respectively, or propensity for risk taking plays a greater role in physicians' clinical decision making. This will be elucidated using regression analyses using state, and trait measures as predictors (PRU-R, IUS, MJPI-R) and admission rates for high and low ambiguity patients as criterion variables. By aggregating these different measures within the same regression analysis it can be determined if these variables are mutually exclusive and if the explained variance of one variable is greater than the other.

Methods

Setting

The study hospital is a Canadian 375-bed acute care institution that serves as a regional trauma and referral centre for a population of 250 000. This facility has the only Emergency

Department within a 100-km radius and provides on-site coverage 24 hours per day, 7 days per week.

Admission process.

The Emergency Department patient admission process at this facility involves the treating physician's initial assessment and investigation. The emergency physician then decides whether the patient should be discharged or if they require further inpatient care and investigation. If the emergency physician feels hospital admission is necessary, he or she would then contact either the patient's admitting family physician or the on-call hospitalist (if the patient does not have an admitting family physician) or specialist (e.g. cardiologist, surgeon) regarding the transfer of care.

Subjects

All Emergency Physicians (N=30) working in the study facility were given the opportunity to participate in the study.

Physician Data Collection

A questionnaire including the Intolerance of Uncertainty Scale (IUS), 2 subscales from the Revised Physician's Reactions to Uncertainty (PRU-R) scales, and the Modified Jackson Personality Index Risk-taking scale (MJPI-R) scale for a total of 41 items was distributed to Emergency Physicians working at the study facility (Appendix A). The questionnaire was estimated to take approximately 15 minutes to complete. One week after distribution a reminder notice was posted requesting physicians to complete their questionnaire and consent form and return it to the researcher's mailbox, physicians were also be reminded to complete their questionnaire at a regularly-scheduled monthly meeting by placing the study in the minutes and a

verbal reminder by one of the researchers. Two weeks after the distribution of questionnaires, a replacement questionnaire was delivered to the in-hospital mailboxes of all Emergency physicians who had not yet returned their questionnaire. All questionnaires were accompanied by a cover letter (Appendix B) and a consent form (Appendix C). Physicians were encouraged to complete the questionnaire but given the option of returning a blank questionnaire as an indication they did not wish to participate. All questionnaires were collected in a manner that protected the anonymity of the physician and only one person had direct access to completed questionnaires and matched consent forms, which were then stored separately. Coded responses were entered into SPSS 17.0 to ensure confidentiality. Questionnaire responses were then matched to individual physician practice data supplied by the hospital and previously collected demographic information that was available as part of a previous research project. The three datasets were matched using a numeric identification system which protected the identity of individual physicians. Only the Primary Investigator had knowledge regarding the identity associated with each of the numeric identifiers. Following the 4 week collection period a debriefing letter (Appendix D) was mailed to all participants.

Patient Data

Patient data was collected from pre-existing hospital records containing demographic (city and province of residence, age, sex, family physician), presenting complaint, whether the patient was admitted, and the length of time from registration to discharge or admission decision.

Patients were grouped into four categories according to the combination of degree of risk and ambiguity associated with their presenting complaint, plus a low risk, low ambiguity control group (Table 1). Physicians' clinical decisions were further analysed based on singular risk

(High, Moderate, Low) and ambiguity (High, Low) levels (Table 2). Patient risk and ambiguity categories were previously arrived at in consultation with a convenience sample of three emergency physicians and two Registered Nurses (RN) with several years of emergency nursing experience, one of whom was employed as an Emergency Department Nurse Manager at the time of consultation.

Patients falling into the highest (CTAS 1) and lowest (CTAS 5) acuity levels were expected to be removed from all analyses because of the low level of uncertainty and ambiguity and expected homogeneity of physician decision making in these cases.

Table 1

Combination Risk and Ambiguity Categories

Category	Description
High Risk, High Ambiguity	Cardiac complaints including chest pain; Abdominal pain
High Risk, Low Ambiguity	Stroke, Transient Ischemic Attack, Cerebral Vascular Accident
Moderate Risk, High Ambiguity	Syncope; Failure to Cope
Moderate Risk, Low Ambiguity	Mental health (e.g. Form 1, Psychosis, Anxiety); Respiratory (e.g. Asthma, Pneumonia, *not* Shortness of Breath); Atrial Fibrillation
Low Risk, Low Ambiguity	Substance use and Abuse (not overdoses)

Table 2

Risk and Ambiguity Category Descriptions

Risk Category	Description
High Risk	Cardiac complaints including chest pain; Abdominal pain; Stroke; Transient Ischemic Attack; Cerebral Vascular Accident
Moderate Risk	Syncope; Failure to Cope; Mental health; Respiratory; Atrial Fibrillation
Low Risk	Substance use and Abuse (not overdoses)
Ambiguity Category	**Description**
High Ambiguity	Cardiac complaints including chest pain; Abdominal pain; Syncope; Failure to Cope
Low Ambiguity	Stroke, Transient Ischemic Attack, Cerebral Vascular Accident; Substance use and Abuse (not overdoses)

Instruments

Intolerance of Uncertainty Scale (IUS).

The English version of the IUS is a 27-item scale that measures emotional, cognitive, and behavioural reactions to ambiguous situations (Freeston, Rheaume, Letarte, Dugas, & Ladouceur, 1997) and one's excessive tendency to consider it unacceptable that a negative event may occur. The IUS has a four-factor structure (the original French version had a five-factor structure, Freeston et al., 1997) consisting of the ideas that uncertainty is stressful and upsetting, uncertainty leads to the inability to act, uncertain events are negative and should be avoided, and being uncertain is unfair. It has excellent internal consistency (α=.94) and good test-retest reliability (r=.74, Buhr & Dugas, 2002). Items are rated on a 5-point Likert scale ranging from

"not at all characteristic of me" to "entirely characteristic of me," with possible scores ranging from 27 to 135.

Revised Physician's Reactions to Uncertainty Scale (PRU-R).

The Physicians' Reactions to Uncertainty Scale, (PRU, Gerrity, DeVellis, & Earp, 1990) and its revised version (PRU-R, Gerrity, White, DeVellis, & Dittus, 1995) measure physicians' affective reactions to uncertainty. The Revised version contains four subscales, two of which will be used for this study: Anxiety due to Uncertainty (five items, including one reverse-scored item) and Concern About Bad Outcomes (three items), Reluctance to Disclose Uncertainty to Patients (five items, including three reverse-scored items), and Reluctance to Disclose Mistakes to Physicians (two items). Only the first two subscales were deemed by the researchers to be relevant to the research questions in the present study. Gerrity et al. (1995) reported good internal consistency on each subscale, with Cronbach's alpha's of .86 and .73, respectively. All items are scored on a 6-point Likert scale ranging from "strongly agree" to "strongly disagree." Total scores from the first two subscales range from 8 to 48. Higher scores indicate a greater reaction.

Modified Jackson Personality Index Risk-taking Scale (MJPI-R).

The Jackson Personality Index (JPI, Jackson, 1976) provides a measure of personality on 15 variables, including 20 items measuring risk-taking. The risk scale has been shown to have good reliability (α=0.81–0.84, Jackson, 1977). Pearson and colleagues (1995) modified the risk-taking subscale for use with physicians resulting in a 6-item scale of physician's risk-taking, called in this paper the Modified JPI-Risk (MJPI-R). Although statements on the JPI were originally scored as "true" or "false," the MJPI-R is scored on a 6-point Likert scale, ranging

from “strongly agree” to “strongly disagree.” Three items on the scale are reverse scored. Possible scores range from 6 to 36, with higher scores indicating a lower propensity for risk-taking. Pearson et al. categorized physicians who score 18 or below as “Risk-seeking” and 20 or above as “Risk-avoiding.” “Risk neutral” physicians have a score of 19.

Analyses

Hypothesis 1

Previous research established a relationship between clinical ambiguity and admission rates in emergency physicians (Nightingale, 1988; Bailey, Klein, & Mutrie, 2009). A t-test will be used to replicate previous findings in this sample of physician admitting behaviour. Physicians’ admission rates will be higher for clinical encounters with high ambiguity patients than moderate ambiguity patients, independent of risk level, showing the impact of situation-specific variables in decision making.

Hypothesis 2

Physicians with more trait intolerance of uncertainty, as assessed by the Intolerance of Uncertainty Scale (IUS) will take longer to arrive at a decision to admit or discharge the patient than lower scoring physicians. Correlational findings from a) the continuous variable, length of stay (LOS) to admission or discharge decision and physicians’ IUS scores will be further strengthened by b) replicating analyses across all five levels of patient ambiguity and risk. Hypothesis #2 builds on Hypothesis #1 by demonstrating the important role of dispositional traits in individual decision makers.

Hypothesis 3

Clinical ambiguity and risk in the patient is expected to relate to physician's reactions to uncertainty (PRU-R) and rates of admission. Correlation analyses with PRU-R and each of four rates of admission (corresponding to each combination of high/moderate risk and high/low ambiguity) will be used to test the hypothesis. The degree of clinical risk and ambiguity in the patients is expected to alter the relationship between physician's scores on the PRU-R and admission rates. A higher degree of ambiguity is expected to strengthen the correlation.

Hypothesis 4

Lower dispositional risk preference, as assessed by the MJPI-R, is expected to be more strongly and positively correlated with a physician's admission rate for higher risk than lower risk patients. Correlations between MJPI-R and admitting in high, moderate and low risk patient categories are expected to increase in strength with increasing associated clinical risk. Physicians who are predisposed to avoiding risk are expected to admit more patients than risk-seeking physicians in when there is more clinical risk inherent in the patient compaint. Subsequent t-tests will identify significant differences among these relationships.

Hypothesis 5

This omnibus regression analysis has three predictor variables; state (PRU-R) and trait (IUS) reactions to uncertainty and physician propensity for risk-taking (MJPI-R), with admission rates for high and low ambiguity patients who fall within the moderate risk level as criterion variables. After establishing the relationship of each of these predictor variables to clinical decision making, this analysis will ascertain which of the dispositional factors plays a primary role in the decision to admit a patient when faced with high or low clinical ambiguity.

Results

Physician Characteristics

Personality questionnaire response rate was 90% (n=27); however, one physician withdrew from the study resulting in 26 physicians. One physician endorsed the maximum possible score on the final scale of the questionnaire, the IUS. The physician was removed from all analyses using the IUS because the score was suspected of being invalid. Overall physicians' scores on the personality scales measuring trait uncertainty (IUS), state uncertainty (PRU-R, including both subscales, Anxiety due to Uncertainty and Concern About bad Outcomes), and propensity for risk-taking (MJPI-R) appear in Table 3.

Demographic data from a previous study utilizing the same physicians was available; however, only twenty physicians had both the demographic information and the personality questionnaires. The following statistics refer only to physicians who completed both the demographic survey and the personality questionnaire and are included for descriptive purposes only. At the time of demographic data collection (June, 2007), in n = 5 (25%) physicians reported having less than three years of emergency medicine experience, n = 7 (35%) had between three and 10 years, n = 5 (25%) had between 10 and 20 years, and n = 3 (15%) reported over 20 years of emergency medicine experience. Of the 20 physicians who completed both the demographic survey and the personality questionnaire, n = 13 (65%) physicians had completed post-graduate training in emergency medicine, n = 15 (75%) were working full time, and n = 15 (75%) reported that during their medical careers, the majority of their clinical practice had comprised of emergency medicine. Where appropriate, partial correlation analysis was used to test the effect of controlling for physicians' years of medical experience, level of post-graduate

training, full time status, and whether they had spent their entire career in emergency medicine. There was no effect and these results are not reported.

Table 3

Emergency Physicians' Personality Variables

	Range			
	Minimum	Maximum	Mean	SD
IUS[a] (27 - 135)	31	102	54	16
PRU-R (8 – 48)	20	47	33	7
Anxiety due to Uncertainty (5 – 30)	11	29	20	5
Concern About Bad Outcomes (3 – 18)	4	18	13	3
MJPI-R (6 – 36)	12	32	21	5

Note. IUS = Intolerance of Uncertainty Scale; PRU-R = Physicians' Reactions to Uncertainty scales; MJPI-R = Modified Jackson Personality Index Risk-taking Scale.
[a]n = 25 for all other measures n = 26.

Comparison of Emergency Physicians and Other Physician Specialists

As part of the literature review information about physicians from different medical specialties with published scores on the personality scales was collected for comparison with the study group. These were available for the subscales of the Physicians' Reactions to Uncertainty scales (PRU-R) and the Physician's Risk Attitude scale (MJPI-R). Compared to the scores of other physicians, including Internists, General Practitioners, and other Emergency Physicians, the Emergency Physicians who participated in this study had a higher mean score (Appendix E1) on each personality measure. On the MJPI-R this means the study group was more risk-avoiding than other physicians and on the two PRU subscales it indicates more Anxiety due to Uncertainty and more Concern About Bad Outcomes in this sample of physicians than was measured in others.

Patient Characteristics

There were 99,850 individual patient visits recorded during the study period, beginning at midnight September 1st, 2008 and ending at 11:59pm August 31, 2009. Physicians in our study treated 75, 973 (76%) of these. The median number of patients seen per physician was 3539 (range: 255-4844, $M = 2922$, $SD = 1491$). Each physician treated patients from each of the 5 CTAS categories. Table 4 shows the CTAS classification and rates of admission for these patients. As expected, there was a small number of patients and very low rate of admission in the CTAS 5 (lowest acuity) category, it was dropped from analyses as planned; however, CTAS 1 patients were retained because between-physician variability in CTAS 1 admission rates was observed. On the basis of the patient's presenting complaint upon entering the Emergency Department, patients were individually coded by the researcher according to the Risk and Ambiguity categories decided on in consultation with experienced Emergency physicians and nursing staff (see Table 1). Frequencies varied across the 5 Risk/Ambiguity categories (Table 5). There were two physicians who did not treat a patient from the High Risk, Low Ambiguity category; these were excluded from subsequent analyses of that variable.

Table 4

Emergency Patient CTAS Classification and Admission Rates

	Total n(%)	Admission Rate[a]	Range (SD)
CTAS 1	719 (0.9)	70.1	50.0-100 (12.1)
2	15 763 (20.7)	29.6	17.7-41.3 (4.9)
3	37 201 (49.0)	8.3	3.9-12.6 (2.5)
4	19 285 (25.4)	0.7	0.0-2.2(0.5)
5	3000 (3.9)	0.4	--

Note. Total n=75 973, 5 cases missing; CTAS = Canadian Triage and Acuity Scale.
[a]Percentage of patients admitted within CTAS category across all Group A physicians.

Table 5

Emergency Patient Risk/Ambiguity Classification and Admission Rates

	Total n(%)	Admission Rate[a]	Range (SD)
High Risk, High Ambiguity	6110 (8.0)	18.6	4.3-31.7 (5.6)
High Risk, Low Ambiguity[b]	219 (0.3)	79.0	0.0-100.0 (22.6)
Moderate Risk, High Ambiguity	814 (1.1)	33.8	12.5-60.0 (13.5)
Moderate Risk, Low Ambiguity	2141 (2.8)	50.3	33.3-63.8 (7.6)
Low Risk, Low Ambiguity	825 (1.1)	4.1	0.0-12.5 (4.0)

Note. Total n = 10, 072.
[a]Percentage of patients admitted within Risk/Ambiguity category across all Group A physicians.
[b]n = 24, all other categories n = 26

Hypothesis 1: High vs. Low Ambiguity Admissions

Based on our preliminary study results, we wished to test the impact of diagnostic ambiguity on physicians' clinical decisions. As hypothesized in the preliminary study, patients in the CTAS 2 and 3 categories tended to be in the High Ambiguity category (78.2% and 72.4%,

respectively). By comparison, patients in the CTAS 1 and 4 categories were less likely to have the High Ambiguity designation; however, only CTAS 1 patients were more likely to be Low Ambiguity than High Ambiguity, (CTAS 4: 65.5% High Ambiguity, and CTAS 1: 46.7% High Ambiguity). A paired-samples t-test tested the hypothesis that emergency physicians' admission rates for higher ambiguity patients would be higher than for lower ambiguity patients. A total of 9284 patient visits were examined, with n = 6924 falling into the High Ambiguity category and n = 2360 in the Low Ambiguity category. Of these, n = 1414 (20.4%) of High Ambiguity patients were admitted to hospital while n = 1259 (53.3%) of Low Ambiguity patients were admitted. A significant value was obtained, (High Ambiguity admission rate: M = 20.64; Low Ambiguity admission rate: M = 51.76), t (df = 25) = -20.03, $p < .01$, showing, contrary to our hypothesis, that a significantly higher rate of admissions for physicians treating lower ambiguity patients (M = 51.76, range: 38.20 to 68.80, SD = 7.20), than higher ambiguity patients (M = 20.64, range: 5.80 to 35.40, SD = 6.16).

Hypothesis 2: Trait Uncertainty and Decision Duration

Our second analysis sought to examine the role of individual decision makers' dispositional traits (i.e. IUS, PRU, MJPI-R) when making a clinical decision. Having more trait intolerance of uncertainty was expected to be related to a longer decision-making time. Correlational analyses were carried out between physicians' scores on the IUS and their mean time to reach an admission/discharge decision across three levels of risk (high, moderate, low) and two levels of ambiguity (high, low). One physician was removed from these and all analyses using the IUS because the validity of that score was questionable. The IUS appeared last in the questionnaire and was the longest scale in the battery which might have contributed to fatigue. The remaining n = 25 physicians' scores on the IUS ranged from 31 to 102, M = 54, SD=15.60.

There was very little variability in physicians' decision making time within the risk and ambiguity levels. Descriptive statistics are presented in Table 6. Only in the Low Ambiguity category was decision making time correlated significantly with physicians' IUS scores, $r = .41$, $p = .04$. The positive correlation shows that physicians who scored higher in trait intolerance of uncertainty also tended to take longer to arrive at a clinical decision when their patients' complaint was least ambiguous. This finding partially supports our hypothesis that having more trait uncertainty would result in longer decision times for Emergency physicians.

Table 6

Mean Time to Disposition Decision by Level of Risk and Ambiguity

	N	Minimum	Maximum	Mean	SD
High Risk	6329	3.6	7.0	5.5	.76
Moderate Risk	2918	3.0	6.6	5.1	.81
Low Risk	825	2.4	6.9	5.1	1.02
High Ambiguity	6924	3.5	7.1	5.6	.80
Low Ambiguity	2360	3.0	6.4	4.8	.71

Note. All time to decision variables are expressed in hours, for example, 7.1 = 7 hours and 6 minutes.

Hypothesis 3: Physicians' Reactions to Uncertainty and Decision to Admit

Degree of clinical ambiguity and risk were only found to correlate with physicians' reactions to uncertainty for admission decisions in the High Risk, Low Ambiguity patient category, $r = .41$, $p = .02$. When patients fall into the High Risk, High Ambiguity; Moderate Risk, High Ambiguity, and Moderate Risk, Low Ambiguity categories, physicians' state reactions to uncertainty (PRU-R) was not found to relate significantly to clinical decision making.

Hypothesis 4: Risk Taking Propensity and Clinical Risk

Physicians' propensity for risk taking (MJPI-R) had a significant moderate positive correlation with High Risk admitting, $r = .42$, $p = .04$. Though not significant, the correlation between Moderate Risk admission rates and risk-taking ($r = .28$, $p = .17$) appeared stronger than for Low Risk admission rates ($r = -.14$, $p = .50$). This finding suggests that as physicians' preference for risk-avoiding went up, so did their admissions for High Risk patients.

Hypothesis 5: Personality as a Predictor of High and Low Ambiguity Admitting

Two stepwise regression analyses were attempted to investigate whether state reactions to uncertainty (PRU-R), trait reactions to uncertainty (IUS), and propensity for risk taking (MJPI-R) would contribute to predicting High Ambiguity and Low Ambiguity admission decisions, respectively. In the first analysis, PRU-R, followed by IUS, then MJPI-R was entered consecutively into to model of predictors with High Ambiguity admission rates as the criterion. None of the variables contributed significantly to the model. In the second regression analysis the same predictors were entered consecutively, using Low Ambiguity admission rates as the criterion variable. Again, none of the predictors contributed to predicting physicians' rates of admission.

Supplementary Analyses

As a consequence of non-significant results from the a priori analyses several subsequent analyses were conducted in an attempt to further examine the relationship between physician personality traits and admission decision making.

Personality variables: Extreme cases.

It was conjectured that the average Emergency Physician's personality scores on the various personality measures were normative and therefore would not be indicative of extreme

scorers. Physicians who were highly intolerant, or highly tolerant, of uncertainty or had a higher or lower inclination toward risk-taking might show a stronger relationship to clinical decision making when separated from the complete sample. The figures in Table E1 highlight that this sample of physicians scored higher on both PRU-R subscales and on the MJPI-R than physicians previously reported on in the medical decision making literature. Consequently, physicians who scored in the 70th and 30th percentiles on the personality measures PRU-R and its subscales, and the IUS, and MJPI-R were separated for comparison and further analyses. Descriptive statistics for the resulting physician groupings are found in Table 7.

Table 7

Mean Personality Scores of 30th and 70th Percentile Ranked Physicians

Personality Variable	Percentile Rank	N	*M*	*SD*
IUS	70th percentile	9	68	14.84
	30th percentile	8	39	5.26
PRU-R	70th percentile	5	43	2.68
	30th percentile	8	24	3.27
Anxiety due to Uncertainty	70th percentile	8	25	2.07
	30th percentile	10	15	1.91
Concern About Bad Outcomes	70th percentile	8	16	1.19
	30th percentile	8	9	2.17
MJPI-R[a]	70th percentile	8	28	2.96
	30th percentile	10	16	1.75

Note. N=26 physicians.
[a]70th percentile physicians have more risk-avoidance, 30th percentile physicians display more risk-seeking

Intolerance of Uncertainty.

We re-investigated whether trait intolerance of uncertainty (IUS) in emergency physicians was related to the length of time before a physician came to a final disposition

decision for patients with High, Moderate, and Low degrees of clinical risk, and High and Low Ambiguity (Hypothesis 2). Correlational analyses were conducted with physicians in the upper and lower tertiles of IUS scores. When physicians scored at or above the 70th percentile of IUS scores, time to decision making was strongly correlated with length of time before clinical decision making for patients in the Moderate Risk category, $r = .88$, $p = .002$, and time before making a clinical decision regarding patients in the Low Ambiguity category, $r = .84$, $p = .004$. When the same analysis was executed for physicians who fell into the lower tertile of IUS scorers the relationships were all in the negative direction, though non-significant. When physicians were more intolerant of uncertainty compared to their peers they tended to take longer to arrive at a clinical decision for Moderate Risk and Low Ambiguity patients, partially confirming our second hypothesis. An Independent samples t-test showed that the mean decision-making times between physicians in the upper ($M = 3.55$ hours) and lower ($M = 3.59$ hours) tertiles of IUS scores did not differ significantly.

Further exploratory analyses revealed that admitting in the CTAS 3 category was strongly and negatively correlated with scores on the IUS that fell at or below the 30th percentile, $r = -.78$, $p = .02$. IUS 30th percentile scores was also significantly correlated with admitting for all Low Ambiguity patients, as defined for this project, $r = -.77$, $p = .03$. Again, the difference in admitting behaviour between physicians with high and low IUS scores was non-significant.

Physicians' Reactions to Uncertainty.

Our third hypothesis sought to explore whether the relationship between state reactions to uncertainty (PRU-R) and physicians' admissions decisions was moderated by the combined degree of clinical Risk and Ambiguity in patients. These analyses could not be repeated as the small number of physicians falling into each of the tertiary group could not support it (see Table

8). In lieu, correlation analyses were undertaken. Results showed that physicians who scored in the highest cohort (n = 5) on this measure of reactions to clinical uncertainty had scores which correlated strongly and positively with decisions to admit patients in the Moderate Risk, High Ambiguity category, $r = .91$, $p = .03$. These physicians admitted more patients in the Moderate Risk, High Ambiguity category as their affective reactions to state uncertainty increased. There were no significant correlations with lower scoring PRU-R physicians' (n = 8) admission rates across the four Risk/Ambiguity categories. This finding partially supports our hypothesis that the relationship between admission decisions and clinical Risk/Ambiguity is different across different degrees of clinical uncertainty.

Further exploratory analyses showed that physicians who scored the highest on this measure of reactions to clinical uncertainty had scores which correlated strongly with CTAS 3 admission rates, $r = -.89$, $p = .04$. The relationship was not replicated for physicians with the lowest 30 per cent of PRU-R scores; however, an Independent samples t-test showed that CTAS 3 admission rates between these two groups were not significantly different ($F = 1.80$, $p > .05$, $t = .272$, $p > .05$). Of physicians with PRU-R scores at or above the 70th percentile, more state uncertainty was related to significantly fewer CTAS 3 patient admissions. Interestingly, physicians with more state uncertainty had a shorter mean decision making time as the variables were significantly and strongly correlated in the negative direction, $r = -.90$, $p = .04$. Physicians' scores below the 30th percentile did not correlate with admitting in any of the CTAS or Risk/Ambiguity categories.

Having more Concern About Bad Outcomes (70th percentile), measured by the PRU-R subscale, was correlated positively with CTAS 1 admitting, $r = .73$, $p = .04$, and with admissions in the Moderate Risk, High Ambiguity category, $r = .82$, $p = .01$. Low Ambiguity admission

rates had a negative relationship with this PRU-R subscale, $r = -.73$, $p = .04$. Physicians' scores which fell below the 30th percentile were positively correlated with CTAS 3 admission rates, $r = .82$, $p = .01$. However, in all of these analyses, Independent samples t-tests showed non-significant differences between CTAS or Risk/Ambiguity level admission rates for emergency physicians based on having subscale scores in the 30th and 70th percentiles. There were no significant correlations between 30th and 70th percentile scores and rates of admitting for the PRU-R Anxiety due to Uncertainty subscale.

Modified Jackson Personality Index Risk-taking Scale.

Our fourth hypothesis sought to show a correlation between emergency physicians' propensity for risk-taking and admissions decisions when faced with clinical situations characterized by differing degrees of clinical risk. In our a priori analyses it was found that having less propensity for risk taking was related to admitting more patients in the High Risk category only. We repeated these analyses, first with physicians from the risk-taking 30th percentile followed by the risk-avoiding 70th percentile. None of the results were significant. Exploratory correlation analyses uncovered no significant relationships between MJPI-R 30th and 70th percentile scores and admitting behaviour.

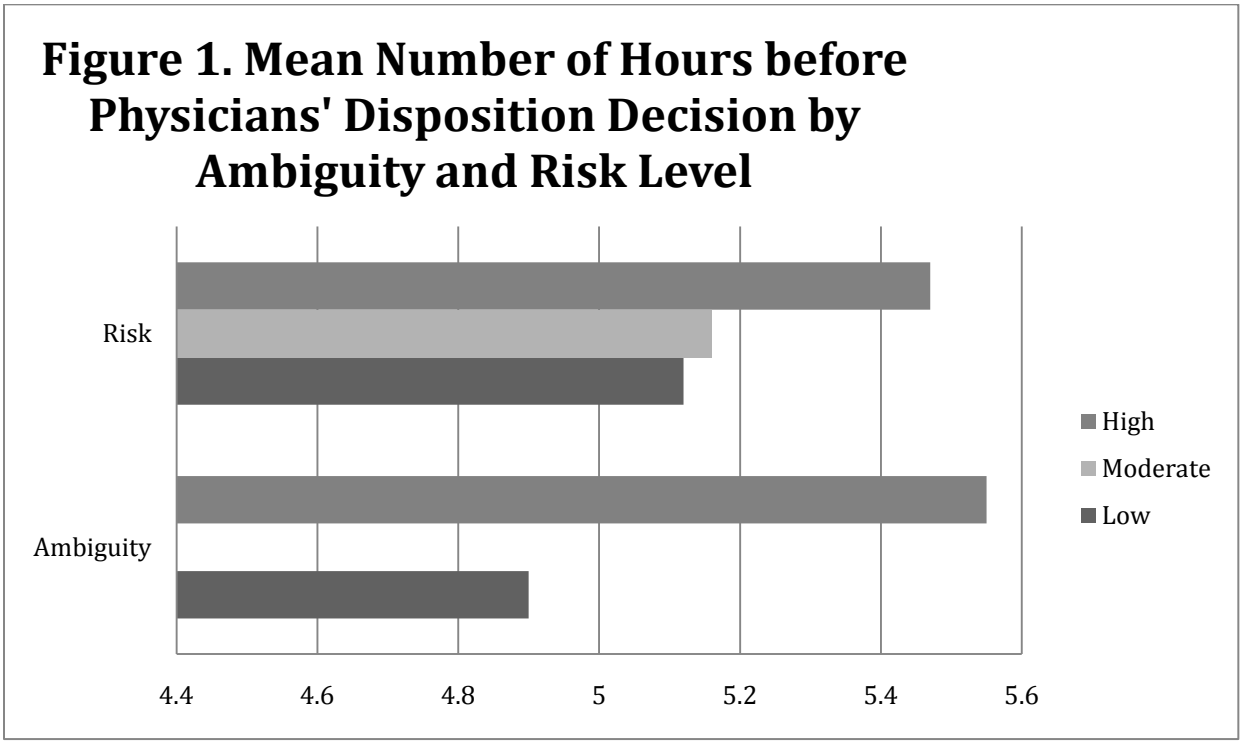
Physicians were then grouped as Risk-Seeking or Risk-Avoiding after Pearson *et. al*. (1995) who categorized physicians with scores of 18 or below as "Risk-seeking" and physicians with scores of 20 or above as "Risk-avoiding." Physicians with a score of 19 were considered "Risk neutral" and left out of analyses.

There were n = 8 physicians in the Risk Seeking group, n = 16 who were Risk-Avoiding, and n = 2 who fell in the Risk-Neutral category. As anticipated, High Ambiguity admission rates correlated positively with Risk Avoiding, $r = .35$, $p = .05$.

We then attempted to replicate Pearson et al.'s finding that Risk-seeking emergency physicians admitted more patients with acute chest pain than Risk-avoiding physicians. Our data only allowed the separation of patients with a cardiac complaint rather than the more specific complaint of chest pain. There was no significant correlation between physicians' Risk-seeking/avoiding and admission rates for cardiac patients, $r = .32$, $p > .05$.

Length of patient stay before disposition decision by a physician.

When faced with making a clinical decision regarding a patient with a complaint typically characterized by different degrees of clinical Ambiguity and Risk, physicians' decision times vary (Figure 1).



Physicians took longer to arrive at a disposition decision for patients who presented with more clinical ambiguity than with a less clinically ambiguous complaint. One-way analysis of variance (ANOVA) showed that there was a significant effect of clinical ambiguity on the

number of hours before a physician's disposition decision was made. $F(1, 9279) = 58.503$, $p<.01$, though the clinical significance of this difference is minimal as the mean time difference between clinical decisions for High Ambiguity and Low Ambiguity patients is roughly 40 minutes. Across both the High and Low Ambiguity patient groups, a longer stay in the Emergency Department prior to a physician's disposition decision was weakly correlated with being admitted, $r = .22$, $p < .01$. The correlation was somewhat stronger for the High Ambiguity category, ($r = .26$, $p < .01$), than for the Low Ambiguity category, ($r = .22$, $p < .01$).

There was a significant effect of degree of clinical risk on the length of time (in hours) before a physician's disposition decision was made, $F(2, 10\ 065) = 9.587$, $p <.01$. Weighted means analysis showed that a linear trend for degree of Risk was present, $F = 16.980$, $p < .01$. Specific contrasts further elucidated these results. Treating High Risk patients significantly increased LOS compared to Low Risk patients, p (one tailed) <.01. Decision making for High Risk patients also significantly increased LOS compared to decisions for Moderate Risk patients, p (two tailed) <.01. Thirdly, Moderate Risk did not have a significant effect on LOS compared to Low Risk patients, p (two-tailed) >.05. Post hoc tests were performed to confirm these results. Hochberg's GT2 was used because sample sizes were uneven and Games-Howell was used because the assumption of equal variances was uncertain at the time of analysis. Both tests confirmed our findings. Although statistically significant, the actual mean time difference between clinical decisions for High Risk and Moderate or Low Risk patients is only about 20-25 minutes.

Discussion

Studies have shown that physicians' decision making and use of resources can differ according to individuals' dispositions toward risk and uncertainty (Allison et al., 1998;

Anderson, Jay, Weng, & Anderson, 1995; Dexter & Tierney, 1994; Fiscella et al., 2000; Gerrity et al., 1990; 1995; Huang, 1998; Gifford, Vickery, & Millman, 1995). The Emergency Department is the gateway to the healthcare system for most patients who are admitted to hospital. Because of increasing demand on limited health care resources, it is important to understand why and under what circumstances physicians utilize resources differently.

We hypothesized that Emergency physicians' state and trait reactions to uncertainty, as well as propensity for risk-taking, would contribute to medical practice pattern variability. Specifically, rates of patient admissions to inpatient hospital wards. The results of this study implicate an inconsistent role of the personality characteristics of state and trait reactions to uncertainty and risk averseness in decision making when situations are characterized by uncertainty, ambiguity, and risk. Despite inconsistent findings this study demonstrated individual variability in decision making within those same situations supporting previously reported findings of individual differences in decision making in uncertain situations and therefore warrants further study.

We conducted this study to elucidate the role of physicians' personality characteristics when making decisions that involve clinical risk and uncertainty. The selection of personality characteristics was theoretically driven based on an integration of the decision making literatures of cognitive and personality psychology. A unique aspect of this study was the inclusion of actual practice data from an applied clinical setting and the subsequent stratification of patients based on the degree of clinical risk and ambiguity associated with their presenting medical illness or complaint.

Physicians' admission rates varied across Risk and Ambiguity categories. The degree of clinical risk and ambiguity associated with common medical complaints was defined by unanimous agreement among a panel of five Emergency Medicine professionals which included experienced physicians and nurses. We coded one year of Emergency Department (ED) registrations from a single hospital site (99, 850 patient visits) based on their medical complaint at the time of registration in the ED. We consider this model of patient stratification to be a major limitation in this study as our analyses attempted to relate the patient's preliminary, likely dynamic, medical issue with an outcome (physician's admission/discharge decision) that occurred up to several hours later. Future studies could examine physicians' clinical decisions along individual treatment pathways rather than taking our macro, single-measure grouping approach. In particular, future researchers could examine Emergency physicians' use of diagnostic tests (as in Allison et al., 1998) or treatment outcomes, especially in relation to length of stay in the ED.

In our sample of 26 Emergency physicians, admission rates were significantly higher for Low Ambiguity patients than for High Ambiguity patients. This result was counter to our hypothesis that more clinical ambiguity would lead to higher rates of admitting by physicians. A review of the types of medical issues faced by patients in these categories (Table 2) provides a potential explanation for these seemingly counter-intuitive findings. Patients presenting with complaints that fell into the High Ambiguity category were made up of primarily (88.2%) cardiac problems and/or abdominal pain, versus the 89.1% of Low Ambiguity patients who presented with mental health or respiratory issues. While our panel of experts agreed that there was more clinical ambiguity in the former category at the time of presentation, these are cases, such as chest pain, where ambiguity can oftentimes be resolved over the course of a typical ED

visit, reducing the likelihood of an admission. By comparison, it is more straightforward (less ambiguous) to identify a patient experiencing an acute psychotic episode, expressing suicidal ideation, or who is in respiratory distress; however, these issues will often require a more extensive inpatient intervention to resolve, resulting in higher rates of admission for Low Ambiguity clinical encounters. The results of our post hoc analyses investigating the length of time physicians took to arrive at a disposition decision for patients across the Ambiguity categories further illustrates this point and informs the potential contribution of personality to decision making.

Responding to the ambiguity in a patient who presents with an unclear and potentially resolvable clinical course could presumably require a longer stay in the ED before a final disposition decision can be made. When an Emergency physician is unclear on a patient's short term prognosis, a longer ED stay may be necessary. Patient complaints defined under the High Ambiguity category appear to fit this profile. Emergency physicians were found to spend approximately 40 minutes longer, on average, with patients in the High Ambiguity category than with patients from the Low Ambiguity category. Upon disposition; however, physicians were more likely to release High Ambiguity patients home than to admit them to hospital. Longer stays in the ED were associated with higher rates of admitting in both the High and Low Ambiguity categories, suggesting that admitted patients might have presented with a more complicated diagnostic profile.

Within physicians who had stronger affective reactions to state uncertainty (PRU-R, 70th percentile) there was an associated shorter decision making latency overall with more extreme PRU-R scores. These physicians also admitted more patients in the Moderate Risk, High Ambiguity category (but not the High Ambiguity category, see below for a further discussion of

the effects of risk on admitting). Unlike their peers, physicians who scored higher in trait uncertainty (IUS) tended to take longer to arrive at a decision regarding Low Ambiguity patients. Taken together these results suggest that when a patient presents with more clinical ambiguity (but potentially a more clear resolution after medical investigations), it takes longer for a physician to come to a decision regarding the patient's disposition (admit or discharge). However, having a personality that predisposes one to feel uncomfortable when faced with situational uncertainty (PRU-R) may hasten the decision making process, potentially as a means of reducing the individual's discomfort associated with clinical uncertainty. Physicians with more dispositional uncertainty (IUS) as a general personality trait may find it less aversive to treat a patient who is less clinically ambiguous and therefore take longer to arrive at a disposition decision for Low Ambiguity patients versus High Ambiguity patients. Future research could include more comprehensive diagnostic information to control more precisely for the effects of specific disease characteristics on clinical decision making.

When patients' presentation was associated with greater clinical risk, physicians' predisposition toward risk was related to admitting behaviour. When Emergency Physicians were characteristically more risk-averse, a high degree of clinical risk associated with a patient's complaint upon presentation in the ED was moderately and positively correlated with admitting more patients to hospital. This result is reminiscent of Pearson and colleagues (1995) who found Emergency physicians from a single ED with more risk-aversion, as measured by the MJPI-R, admitted twice as many chest pain patients as risk-seeking physicians. When we attempted to replicate this analysis, adding only patients with cardiac complaints into the analysis (we could not separate chest pain patients from the cardiac group with the coding system used, to fully mimic the Pearson et al. study), the result was non-significant. Future investigations could

undertake a more accurate replication of the Pearson et al. study, or investigate the role of physician personality on admitting within other specific diagnostic categories.

Decision making time increased in a linear fashion from Low Risk, through Moderate to High Risk; however, the effect was only significant when comparing Moderate or Low Risk decision times to the duration of High Risk decisions. As previously discussed, admission rates did not follow the same linear pattern. Mean admission rates were highest in the Moderate Risk category (56.5%) versus the High Risk (20.6%) and Low Risk (4.0%) categories. Given that the actual decision time difference between High Risk and Low Risk patients was less than 30 minutes, this result was not surprising, despite the positive relationship between longer decision latency and increased patient admissions overall.

Our preliminary study found that PRU-R subscale scores contributed significantly to the prediction of CTAS 2 and CTAS 3 admission rates. Furthermore, it was hypothesized in the original study that urgent (CTAS 2) and emergent (CTAS 3) patients were more clinically ambiguous than patients in the severe (CTAS 1) and less urgent (CTAS 4) categories, and that this patient characteristic could explain the role of reactions to uncertainty in physicians' clinical decision making. The finding that CTAS 2 and 3 patients were higher in ambiguity than patients from the remaining CTAS categories was confirmed; however, the difference between groups was not substantial. When the complete set of stepwise regression analyses from the preliminary study were repeated with this more extensive patient dataset (6 months versus 12 months of ED visits; and n = 20 versus n = 26 physicians), none of the personality variables were significant predictors of CTAS-level-specific admission decisions (not reported). There are several possible explanations for the inconsistency in results.

The number of daily Emergency Department visits at the study site is not evenly distributed over all 12 months of the year. Data from the preliminary study was collected over a six-month period but represented only approximately 38% of patient visits for that year. The comparison analyses were carried out on a full 12 months of patient visits. An increased demand on hospital and physicians' mental resources could affect the interaction of clinician personality and patient characteristics. When information-processing demands are high, people tend to rely more heavily on heuristics and biases (Finucane, Alhakami, Slovic, & Johnson, 2000; Macrae, Hewstone, & Griffiths, 1993). As such, it is possible that increased patient visits altered the relationship between physician personality variables and clinical decisions when a full year of patient visits was considered. Future studies should consider the rate of patients seen in addition to the rate of admission and consider variability over time.

Most probably our earlier findings are the result of a Type I error, the null hypothesis that there would be no effect of physician personality on admissions decisions was mistakenly rejected. The converse side of that is that our present significant results could be a Type II error and we failed to detect a significant effect that in fact exists. Substantially increasing the number of physicians in our sample would significantly reduce the chance of both types of errors and the impact of individual outliers in our sample. The growing availability of electronic health records and information, along with the Internet for enhanced dispersion of surveys, makes more inclusive studies using larger samples of physicians more feasibly than previously the case. Using a broader physician base would likely have provided more valid results concerning the impact of physician disposition on clinical decision making and reduced the chance of a Type I or Type II error. Additionally, controlling for or comparing physicians nested within hospitals and/or regions could increase our understanding of the effects of cultural and population

differences between Emergency Departments as well individual personality differences within them.

There is some evidence to suggest that this sample of physicians differs from physicians whose personality and patterns of practice was previously studied and those with whom the personality instruments were originally constructed. Specifically, the participants in our study had stronger affective reactions to uncertainty, both in their anxiety due to the uncertainty of the present situation and in their concern over future outcomes for the patients they treated. Unfortunately, there were no published norms available for Emergency Physicians on this measure.

Additionally, this sample of Emergency Physicians had mean scores placing them in the Risk-avoiding category of the MJPI-R versus the Risk-neutral Emergency physicians who participated in the study of Pearson et al. (1995) and the Risk-seeking Internists reviewed by Allison and colleagues (1998, Table 4). In the sample of General Practice physicians who participated in a study by McKibbon and colleagues (2007) the physicians were divided equally between the Risk-seeking and Risk-avoiding categories with 11 physicians in each group and two physicians were categorized as Risk-neutral. McKibbon et al.'s study did not provide mean scores to the reader. By contrast, in our sample Risk-avoiding physicians outnumbered Risk-seeking physicians by a ratio of 2:1. Given the fast-paced nature of Emergency Medicine, its inherent need to make oftentimes critical, time-sensitive clinical decisions with minimal evidence or investigations, and the typical lack of feedback regarding the outcomes of those decisions, propagating norms for Emergency physicians represents an important contribution to the Emergency Medicine literature in particular and the broader decision making literature in general.

Summary

Emergency physicians vary in their admissions decisions for patients who initially present with differing levels of clinical risk, ambiguity, and illness severity (CTAS). Individual reactions to state uncertainty, trait uncertainty, and risk-aversion/risk-seeking does not play a clear role in Emergency physicians' decision to admit patients based on level of patient ambiguity and risk. This was the first known study to investigate the relationship between physicians' personality characteristics and actual admission decisions given patients' clinical characteristics. As such, it represents a novel approach to delineating under what clinical circumstances aspects of personality plays a more impactful role in decision making. The results of this study illuminate and remind the author of the intricacies of the human decision making process and in some way explains why its' study has captivated and frustrated the imagination of researchers for over 400 years.

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Appendix A

Physician Survey

For the following items, circle the most appropriate response between 1 and 6, where 1=*Strongly Agree* and 6=*Strongly Disagree*.

	1=*Strongly Agree*					**6=*Strongly Disagree***
I usually feel anxious when I am unsure about a diagnosis.	**1**	**2**	**3**	**4**	**5**	**6**
I find the uncertainty involved in patient care disconcerting.	**1**	**2**	**3**	**4**	**5**	**6**
Uncertainty in patient care makes me uneasy.	**1**	**2**	**3**	**4**	**5**	**6**
I am quite comfortable with the uncertainty in patient care.	**1**	**2**	**3**	**4**	**5**	**6**
The uncertainty of patient care often troubles me.	**1**	**2**	**3**	**4**	**5**	**6**
When I am uncertain of a diagnosis, I imagine all sorts of bad scenarios- patient dies, patient sues, etc….	**1**	**2**	**3**	**4**	**5**	**6**
I fear being held accountable for the limits of my knowledge.	**1**	**2**	**3**	**4**	**5**	**6**
I worry about malpractice when I do not know a patient's diagnosis.	**1**	**2**	**3**	**4**	**5**	**6**
I enjoy taking risks.	**1**	**2**	**3**	**4**	**5**	**6**
I try to avoid situations that have uncertain outcomes.	**1**	**2**	**3**	**4**	**5**	**6**
Taking risks does not bother me if the gains involved are high.	**1**	**2**	**3**	**4**	**5**	**6**
I consider security an important element in every aspect of my life.	**1**	**2**	**3**	**4**	**5**	**6**
People have told me that I seem to enjoy taking chances.	**1**	**2**	**3**	**4**	**5**	**6**
I rarely, if ever, take risks when there is another alternative.	**1**	**2**	**3**	**4**	**5**	**6**

For the following items, circle the most appropriate response between 1 and 5, where 1=*not at all characteristic of me* and 5=*entirely characteristic of me*.

	1=*not at all characteristic of me*				**5=*entirely characteristic* of *me***
Uncertainty stops me from having a firm opinion.	**1**	**2**	**3**	**4**	**5**
Being uncertain means that a person is disorganized.	**1**	**2**	**3**	**4**	**5**
Uncertainty makes life intolerable.	**1**	**2**	**3**	**4**	**5**
It is unfair not having any guarantees in life.	**1**	**2**	**3**	**4**	**5**

	1=*not at all characteristic of me*				**5=*entirely characteristic* of *me***
My mind can't be relaxed if I don't know what will happen tomorrow.	**1**	**2**	**3**	**4**	**5**
Uncertainty makes me uneasy, anxious, or stressed.	**1**	**2**	**3**	**4**	**5**
Unforeseen events upset me greatly.	**1**	**2**	**3**	**4**	**5**
It frustrates me not having all the information I need.	**1**	**2**	**3**	**4**	**5**
Uncertainty keeps me from living a full life.	**1**	**2**	**3**	**4**	**5**
One should always look ahead so as to avoid surprises.	**1**	**2**	**3**	**4**	**5**
A small unforeseen event can spoil everything, even with the best of planning.	**1**	**2**	**3**	**4**	**5**
When it's time to act, uncertainty paralyses me.	**1**	**2**	**3**	**4**	**5**
Being uncertain means that I am not first rate.	**1**	**2**	**3**	**4**	**5**
When I am uncertain, I can't go forward.	**1**	**2**	**3**	**4**	**5**
When I am uncertain I can't function very well.	**1**	**2**	**3**	**4**	**5**

	1=*not at all characteristic of me*				***5=entirely characteristic* of *me***
Unlike me, others always seem to know where they are going with their lives.	**1**	**2**	**3**	**4**	**5**
Uncertainty makes me vulnerable, unhappy, or sad.	**1**	**2**	**3**	**4**	**5**
I always want to know what the future has in store for me.	**1**	**2**	**3**	**4**	**5**
I can't stand being taken by surprise.	**1**	**2**	**3**	**4**	**5**
The smallest doubt can stop me from acting.	**1**	**2**	**3**	**4**	**5**
I should be able to organize everything in advance.	**1**	**2**	**3**	**4**	**5**
Being uncertain means that I lack confidence.	**1**	**2**	**3**	**4**	**5**
I think it is unfair that other people seem sure about their future.	**1**	**2**	**3**	**4**	**5**
Uncertainty keeps me from sleeping soundly.	**1**	**2**	**3**	**4**	**5**
I must get away from all uncertain situations.	**1**	**2**	**3**	**4**	**5**
The ambiguities in life stress me.	**1**	**2**	**3**	**4**	**5**
I can't stand being undecided about my future.	**1**	**2**	**3**	**4**	**5**

Please remember to sign and return the attached consent form with your questionnaire.

Thank you for your participation!

Appendix B

Recruitment Letter

Dear Potential Participant;

We would like to invite you to participate in a study we are conducting of emergency physicians' personality factors and admitting practices. The research project title is "Physician Uncertainty and the Decision to Admit," and the principal researcher is Rupert Klein, PhD, professor in the Psychology Department at Lakehead University. This project was introduced and discussed briefly at the September 16, 2008 departmental/Thunder Bay Emergency Physicians (TBEP) meeting at Thunder Bay Regional Health Sciences Centre (TBRHSC).

Very little research has been done on the impact of personality factors and decision-making in the Emergency Department (ED). The intent of this research project is (a) to test the validity of a proposed short version of the Intolerance of Uncertainty Scale (IUS), (b) to test the validity of the Revised Physicians' Reactions to Uncertainty (PRU-R) scales on a sample of EPs, (c) to investigate the relationship between ED physicians' degree of intolerance of uncertainty and CTAS-specific admission rates, and (d) to explore the association between physician risk attitudes and the decision to admit a patient. To accomplish this goal we would like you to fill in the attached questionnaire concerning your attitudes and beliefs about certain situations. This will require approximately 15 minutes of your time. Collected data will be matched to previously collected demographic and admission rate data for secondary data analysis.

All information you provide will be coded using a numeric identification system known only to one of the co-investigators (Kathleen Bailey) and your identity will be kept confidential at all

times. Data files containing both questionnaire responses and information about admissions will not contain any information regarding the identity of participants. All questionnaires will be kept in a secure location for 5 years and then destroyed, as per Lakehead University research policy. Electronic data files will be kept for possible use in future research projects. Your name, or any other identifying information, will not be revealed in any published materials resulting from this study.

There are no known risks or benefits to physicians taking part in this study, however, should you wish not to participate we ask that you please return the questionnaire blank, as an indication that you have chosen to opt-out of the project. You may choose not to answer any question. There will be no consequences for any physician choosing not to participate fully and you may drop out at any time by contacting the researcher who will remove your data from the analysis.

If you have any questions or concerns, please do not hesitate to contact the co-investigator at 474-8453, skbailey@lakehadu.ca or Dr. Klein at 343-8535, rgklein@lakeheadu.ca. You may also contact Lakehead University's Research Ethics Board at 343-8283 or the TBRHSC Research Ethics Team at 684-6422.

Thank you for your time and cooperation. The findings of this project will be made available to you at your request upon completion of the project. This letter is yours to keep.

Sincerely,

Kathleen Bailey

MSc Candidate (Psyc)

Appendix C

Consent Form

Dear Potential Participant;

By signing below you are confirming that you have read and understood the attached cover letter concerning the research study "Physician Uncertainty and the Decision to Admit," and have agreed to participate.

Further, you acknowledge that you understand that there are no known or expected risks involved in participating in this study, but that you may still choose to withdrawal at any time by contacting any of the researchers using the contact information provided on the cover letter, similarly you may choose to leave some items on the questionnaire blank.

All information collected as a part of this study will be kept in a secure location in the Principal Investigator's lab (Personality and Health Psychology Lab) for 5 years and then destroyed, there will be no way to of identifying individual physician's questionnaires and this signed consent form will be kept separately to protect your anonymity. Electronic data files will be securely stored and may be used in future research projects by members of the research team. Electronic files will be kept free of possible identifiers.

The findings of this research project will be made available to you at your request. Any publication/public presentation of the findings will not identify individual physicians.

Signature of Participant: _____

Printed Name: _____

Date: _____ 2008

Thank you again for your consideration,

Sincerely,

Kathleen Bailey

MSc Candidate (Psyc)

Appendix D

Debriefing Letter

Thank you for your participation in this research project on physician's intolerance of uncertainty, risk attitudes, and admitting behaviour.

The aim of the study is to investigate the association between Emergency Physicians' personality traits and medical decision-making. Specifically, we are studying an individual's intolerance of uncertainty and risk attitudes and how this impacts a decision in an ambiguous circumstance. Intolerance of uncertainty is the "excessive tendency of an individual to consider it unacceptable that a negative event may occur, however small the probability of occurrence (Dugas, Gosslin, & Ladouceur, 2001, p552). Previous studies have found that intolerance of uncertainty is related to overestimation of the consequences and probability of negative outcomes as well as an association with the amount of evidence a person gathers before making a decision. The researchers have hypothesized that in groups of physicians where intolerance of uncertainty is high, they will admit more patients and that this is most likely to occur in the often-times ambiguous ED environment. Researchers have studied risk aversion, risk seeking and risk avoiding behaviour in physicians in relation to their admitting practices, referral rates, and resource use but these studies have been limited to Internist, Family Medicine, and Surgical populations. Self-report measures of risk attitudes have shown good cohesion with measures of intention to reduce risk, and the decision to admit certain patients could be an attempt to reduce risk-related discomfort felt by physicians. The relationship between physician risk attitudes and admitting practices may be mediated by diagnostic ambiguity or illness severity, but this line of research needs to be examined further. Particularly, the effect of risk attitude on admitting practices in high pressure, time-limited environments warrants exploration. With this in mind

we will explore whether the relationship between emergency physicians' risk attitude and admission rates will be mediated by patient acuity.

The questionnaire you completed consisted of three parts:

a) Revised Physicians' Reactions to Uncertainty Scales (PRA-R); subscales 1 & 2: Anxiety due to Uncertainty subscale and Concern About Bad Outcomes subscale;

b) Physician Risk Attitude (PRA);

c) Intolerance of Uncertainty Scale (IUS).

These scales were matched to physician admission rate data and demographic information collected as part of an earlier study for secondary data analysis.

A summary of the results will be available by mail or email to interested individuals who provide their name and mailing address or email address to the researcher.

For further information or to answer any questions concerning the aforementioned questionnaire you completed, please contact Kathleen Bailey (807-474-8453 or skbailey@lakeheadu.ca) or Dr. Rupert Klein, at the Department of Psychology, Lakehead University (807-343-8535 or rgklein@lakeheadu.ca).

Reference

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Appendix E

Table E1.

Comparison of Emergency and Other Physicians on Personality Variables

	Specialty (n)	Mean	Range (min-max)	SD
Revised Physicians' Reactions to Uncertainty (PRU-R)				
Anxiety due to Uncertainty				
Gerrity, et al. (1995)	Internal Medicine (262)	18.8	5-30	--
Allison, et al. (1998)	Internal Medicine (20)	14.2	7-24	3.4
Legare et al. (2006)	General Practice (112)	15.2	--	4.7
Schneider et al. (2007)	General Practice (93)	17.6	5-30	6.2
Bailey et al. (2009)	Emergency Medicine (26)	20	11-29	4.6
Revised Physicians' Reactions to Uncertainty (PRU-R)				
Concern About Bad Outcomes				
Gerrity, et al. (1995)	Internal Medicine (262)	9.5	3-18	--
Allison, et al. (1998)	Internal Medicine (20)	8.3	4-14	2.7
Schneider et al. (2007)	General Practice (93)	8.2	3-18	3.9
Bailey et al. (2009)	Emergency Medicine (26)	12.8	4-18	3.3
Physician Risk Attitude Scale (MJPI-R)				
Allison, et al. (1998)	Internal Medicine (20)	16	10-24	3.3
Pearson et al. (1995)	Emergency Medicine	19	11-30	4.0
Bailey et al. (2009)	Emergency Medicine (26)	21	12-32	5.2